Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Inquiry Regarding Carrier Current Systems,	)	ET Docket No. 03-104
including Broadband over Power Line Systems	)	
	)	
	)	

COMMENTS TO NOTICE OF INQUIRY

NORTH AMERICAN SHORTWAVE ASSOCIATION
45 Wildflower Road
Levittown, PA 19057
June 30, 2003

ABSTRACT

Access BPL and In-House BPL devices using HF frequencies are incompatible with international broadcast reception in the International Telecommunications Union (ITU)-allocated spectrum between 2 and 26 MHz. After investigating the same issues currently before the FCC in this docket, Japan has refused to authorize deployment of such systems at this time due to interference concerns. The Telecom Agency of the Dutch Government has abandoned their plans to deploy BPL after determining through measurements that such signals cause interference to radio communications.

Avoiding certain frequency bands has been suggested as a way to protect duly licensed HF services. Proposed plans to insert notches in the spectrum will limit ITU and FCC flexibility to reassign HF spectrum as future needs evolve. This practice will forever constrain the FCC and ITU to allocations that exist today. Once the BPL technology is widely deployed, the cost to change frequency allocations to accommodate evolving spectrum needs will be prohibitive. Foreclosing the FCC's right to realign spectrum usage in the future is not good public policy.

NASWA recommends all BPL signals be confined to the 30 to 47 MHz region of the spectrum to minimize interference to international broadcast services
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I. INTRODUCTION

The North American Shortwave Association (NASWA) represents the interests of persons in the United States and Canada who choose to obtain information on international news events and other cultures directly from the source. These persons use shortwave radio broadcasts from other countries to receive information, unfiltered by domestic intermediaries. The international broadcast shortwave spectrum is defined as those bands allocated by the ITU for broadcasting between 2 and 26 MHz. The terms HF and shortwave are used interchangeably in this response.

The number of shortwave listeners in the USA is hard to estimate accurately since Arbitron does not survey such listeners. The CIA Factbook says there are 575 million radios here. If only one percent of these radios have shortwave capability, that would be almost 6 million shortwave receivers. A reasonable estimate would be that hundreds of thousands of listeners tune in to shortwave broadcasts weekly.

As wonderful as enhanced broadband competition could be for improving our access to information, the use of free-to-air shortwave radio broadcasts by hundreds of thousands of weekly listeners is a right that must be protected by the FCC.

Shortwave broadcasts are accessible to even the poorest people for a one-time equipment cost of less than $150. In its efforts to expand subscription-supported broadband Internet access, the Commission must not force economically deprived persons to incur monthly subscription costs or purchase a relatively high-cost interface device, such as a computer, to access information available today for free. A free democratic society depends on free access to information in order to have an informed electorate. The effective exercise of democracy demands that all persons have an inherent right to inform themselves regardless of economic status. The FCC must, therefore, protect the public interest by protecting existing methods of access to free information.

NASWA welcomes this opportunity to comment on the potential use of broadband power-line communications (BPL) to improve Internet access while protecting methods used by many today to receive their information freely via shortwave radio.

II. BACKGROUND

Most new shortwave radios sold in the United States and the world today are portable radios using small whip antennas and very sensitive electronics to make up for the small antenna size. These radios are often used in residential and office type environments where the small antenna is in close proximity to power lines embedded in the walls of such structures. Such radios are particularly vulnerable to interference radiated by unshielded power wiring because of the close proximity to such wires. When Part 15 rules were developed, most shortwave radios were tabletop devices or floor model consoles using external antennas fed by shielded coaxial cables. External antennas could often be located tens of meters from power wires. The shielded feed lines provided good protection from unintentional radiators.

As more and more people began living in closer proximity to one another, the ability to physically isolate antennas from the noise environment, has eroded. Apartment and condominium dwellers are largely prohibited from installing outside shortwave receive antennas. Portable radios often do not have access connectors for external antennas using shielded feed lines. Even in developments of freestanding houses, often six or more homes are connected in parallel at the output of the power distribution transformer. This parallel connection allows interference components to be conducted via the power lines from one home to another. Thus, the shortwave radio user does not have the option of unplugging offending devices when interference comes from a neighbor's home. Because of this vulnerability, the Commission should be particularly sensitive to special precautions that must be taken to protect listeners from both conducted and radiated forms of interference.

Because NASWA's interests are somewhat limited in scope compared to the overall objectives of the Commission's inquiry, NASWA has elected to respond only to paragraphs of the inquiry in which it has experience or knowledge. In the following response, the selected paragraphs of the FCC inquiry have been repeated followed by the NASWA response.

III. DISCUSSION

FCC Inquiry:

Several consortiums have been organized to promote Access BPL and its applications; however, the operating characteristics of Access BPL are not standardized. In order to assist us in understanding the

current state of Access BPL, we seek comment and information in response to the following questions:

- What spectrum and bandwidth would Access BPL use? We have granted experimental licenses to some parties under 47 C.F.R. § 5 to evaluate Access BPL equipment that operates from 1.7 to 80 MHz. Would Access BPL devices operate in other portions of the spectrum and at what bandwidth?

NASWA Response:

Access BPL systems must protect the internationally allocated frequency bands between 5.5 and 26 MHz which are used by international broadcasters to reach listeners in the USA. (If the FCC desires to adopt a standard that will be marketable in foreign countries, attention must also be directed to internationally allocated bands between 2.0 and 5.5 MHz which are in use for both domestic and international broadcasting in many parts of the world.)

- Notches in the BPL spectrum have been proposed to protect various licensed radio services. It is dangerous to carve out holes in the allowable radiated spectrum from Access BPL devices because that will forever constrain the flexibility the ITU and the FCC have in adjusting the HF broadcast bands to accommodate changing needs. Once the Access BPL physical plant is widely deployed, the cost of modifying the plant to accommodate new broadcast frequency allocations will be prohibitive. Frequencies used by international broadcasters between 2.0 and 26 MHz are defined and allocated by the International Telecommunications Union (ITU) through its periodic World Administrative Radio Conferences. These allocations are somewhat dynamic and have been expanded over the years to accommodate the growing needs of broadcasters and listeners.

- HomePlug® Alliance members have demonstrated their technology for use in the Access BPL application. Their frequency spectrum is representative of other approaches and ranged from 4.5 to 21 MHz. Assuming this 16.5 MHz of bandwidth is actually necessary to achieve data rates that would be economically competitive with cable and DSL access methods, NASWA alternatively recommends the spectral region between 30 and 47 MHz be considered for both Access BPL and In-House BPL applications. Users are declining in this frequency range as public safety and law enforcement services migrate to 800 MHz trunked systems. This migration to higher frequencies is being spurred by the increased need for liaison between emergency response agencies. Effective homeland security also requires protecting law enforcement communications from eavesdroppers. Digital trunked systems in the 800 MHz range improve both interoperability between agencies and secure communications from casual eavesdroppers.

- The US military also uses frequencies in the 30-47 MHz range for mobile communications. Because these communications are not normally connected to or in proximity to residential power distribution lines, the effect of joint use of these frequencies should be minimal. Additional testing is recommended to verify this assumption.

- Adoption of the 30-47 MHz range will likely reduce the cost of implementation of BPL technology because the filtering and shielding required would not be as demanding in the 30-47 MHz range as it is at HF. Because there are few actual users of the recommended 30-47 MHz frequency range, FCC enforcement costs, which would otherwise be incurred in investigating interference complaints, will be greatly reduced. The FCC should be careful when assessing the occupancy of this frequency range. Some public safety and law enforcement agencies are holding on to their licensed allocations in this range even though they have largely abandoned such use for more suitable frequencies. The equipment is still available and these public safety agencies want to hold on to their licenses until they gain confidence in the reliability of the newer

technologies. Once that confidence is achieved, it is likely these licenses could be relinquished with little loss of coverage or reliability.

FCC Inquiry:

- Is the spectrum used by Access BPL shared with In-house BPL? Are there any frequency sharing issues to be considered, *i.e.*, should we designate spectrum for Access BPL and In-House BPL? Is spectrum sharing between Access BPL and In-House BPL feasible?

NASWA Response

- At least one HomePlug® Alliance member has recently demonstrated their In-House BPL standard modem works in the Access BPL application. NASWA recommends that the HomePlug® standard be modified to move the signals in the 4.5 to 21 MHz region up to 30 to 47 MHz to avoid interference to international broadcast reception.

FCC Inquiry:

- In order to transfer high frequency signals beyond the low-voltage distribution transformer, Access BPL systems use high-pass filter circuits to bypass the transformer and its inherent low-bandwidth characteristics. What is the effect of these high-pass filters with respect to high-frequency signals used inside the house, *e.g.*, from In-House BPL equipment or other in-premises technologies, that may rely on the low-voltage transformer as a natural barrier to avoid causing interference at higher frequencies?

NASWA Response:

- The presence of high-pass filters to facilitate bypassing of distribution transformers will inevitably cause an increase in unwanted interference conducted and/or radiated from the medium voltage wires of the power distribution network and the low voltage wiring in the home. These transformers normally act to limit propagation of such noise components. Noise components originating in homes tend to be confined to the homes connected in parallel at the secondary winding of the distribution transformer. High Frequency (HF) noise components developed upstream of the distribution transformer are inhibited from reaching residential customers by the reactance presented by the transformer at HF frequencies. Bypassing these transformers at HF frequencies will allow the high voltage distribution network to propagate the interference components both out of the home to the medium voltage distribution network and in the reverse direction from sources well beyond the immediate vicinity of the home user of shortwave radio broadcasts.

- NASWA recommends transitioning the communications signals to fiber-optic technology at the secondary of the distribution transformer. The communications signals should never reach the medium voltage (1000-40,000 volt) side of the transformer. The transformers will then continue to confine interference-causing spectral components to the geographical region defined by those homes connected to the distribution transformer secondary.

FCC Inquiry:

For Access BPL systems, several methods of RF signal injection onto the medium voltage lines can be envisioned:

- An RF voltage could be applied between a power line and ground;
- An RF voltage could be applied differentially between two phases of a power line; or
- A single power line wire could be driven as if it were a dipole antenna—*e.g.*, by inductively coupling RF energy to it.

Other approaches may also be possible. What methods are being considered for signal injection onto the medium voltage lines? What are the implications on radiated emissions of various methods for injecting signals onto the medium voltage lines (*e.g.*, differences in directional characteristics and magnitudes of the emitted fields)?

NASWA Response:

- NASWA recommends that the medium voltage distribution network not be used for transmission of communications signals due to the high probability of conducted and radiated coupling of interference to HF broadcast radio services. Instead, the communications signals should transition to fiber-optic technology at the distribution transformer secondary.

FCC Inquiry:

- Is there a need to define frequency bands that must be avoided in order to protect the licensed users on the same frequencies as those used by Access BPL systems? Are there mitigation techniques Access BPL systems can use to avoid possible interference with licensed users of the spectrum, such as mobile users or public safety and law enforcement users who may be traveling directly beneath the medium voltage lines?

NASWA Response:

- Defining holes in the spectrum that must be protected to prevent interference is a dangerous approach from a public policy viewpoint. Once these systems are widely deployed, the FCC will be unable to modify existing spectral assignments while keeping services protected without extensive rebuilding of the BPL infrastructure. Such a rebuild will likely be cost-prohibitive effectively locking the FCC into today's frequency allocations forever. The ITU's and the FCC's ability to modify spectral assignments as demand for different services evolve should not be forever constrained by the design of a widely deployed BPL technology. Notches in the spectrum to limit ingress and egress of interfering signals are not a long-term solution to radiated and conducted interference. The better solution is to move all these systems to relatively unused portions of the spectrum between 30 and 47 MHz.

FCC Inquiry:

- Since Access BPL equipment is installed on medium voltage lines that supply electricity to a residential neighborhood, should this equipment be treated as operating in a residential (Class B) or commercial (Class A) environment?

NASWA Response:

- The more restrictive limits of the residential Class B restrictions should apply. The logic is that the medium voltage lines pass through residential neighborhoods. The lines are often less than 10 meters from receiving antennas used by persons desiring to access international HF radio

broadcasts.

FCC Inquiry:

- What mitigation techniques are used by In-House BPL systems to avoid possible interference with licensed radio services, such as amateur radio, fixed, mobile and broadcast services? Is there a need to define frequency bands that must be avoided in order to protect the licensed services that use the same frequencies as In-House BPL systems?

NASWA Response:

- The HomePlug® Alliance has worked in cooperation with the American Radio Relay League (ARRL) to measure and mitigate interference to HF amateur radio service communications. They carved out particular portions of the HF spectrum that caused interference to and were susceptible to amateur radio operations. Such frequencies are protected in the HomePlug® standard. The mask provides 30 dB of additional protection at amateur band frequencies as shown in Figure 1 extracted from a joint ARRL/HomePlug® Alliance test report which can be found at:

  http://www.arrl.org/tis/info/HTML/plc/files/HomePlug_ARRL_Dec_2000.pdf

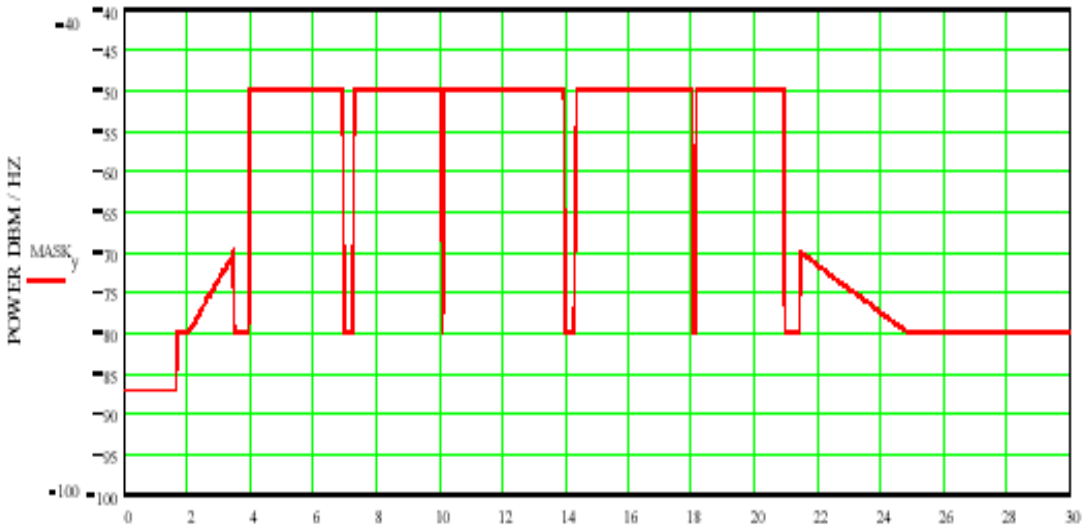

Figure 1: Notches in the BPL spectrum can help mitigate interference but will constrain future FCC flexibility to reassign spectrum.

- The approach of protecting certain HF frequencies and not others is not in the public interest. For example, the approach shown in Figure 1 protects today's amateur radio frequencies but does nothing to protect the ability of persons to access international broadcast transmissions. This approach forever constrains the flexibility the FCC must have to re-allocate frequencies as communications technologies, market forces and what constitutes the public interest evolves. The economic cost of modifying installed BPL plant equipment would be used by the BPL industry to try to intimidate the FCC from making allocation changes that would otherwise be judged to be in the public interest. Notches in the spectrum are, therefore, not the best way to mitigate the interference problem. Moving the data signals to the range of 30 to 47 MHz, as

recommended by NASWA, would be a much better solution.

FCC Inquiry:

- What are the probable interference environments and propagation patterns of Access BPL and In-House BPL systems? Are there specific issues of interference that we should address, *e.g.* an increase in the level of the noise floor? What models are available for predicting radiated emissions from access BPL systems?

NASWA response:

- The FCC must consider usage patterns. The interference emitted by the neighbor's drill, even if it exceeds Part 15 limits for incidental radiators, might be tolerable because the drill is used only infrequently. The BPL devices will be on continuously. To the deleterious effect of such a device in one's own home must be added the cumulative effect of all the BPL devices in neighbor's homes that share the same secondary winding of the distribution transformer. Relocating the spectrum to the range of 30 to 47 MHz would eliminate any cumulative effect on HF broadcast reception.

- NASWA cautions against use of computer modeling to try to predict allowable interference limits. There are just too many variables to model and no two homes are exactly the same. NASWA suggests instead that numerous impartial field trials be conducted and radiated interference levels measured using off-the-shelf "shortwave" radios as standards. NASWA recommends the Grundig YB-400 as being both typical and popular. YB-400 receivers are sold by Radio Shack and several specialty shops. They are widely advertised by Grundig in Time Magazine with 800 telephone numbers for direct ordering. The standard should be that BPL devices of both the in-house and BPL Access types should not be detectable by such a receiver operating on its own antenna between 2 and 26 MHz anywhere in the house more than a meter away from a wall. Real-world tests and demonstrations are currently being conducted by power utilities. The FCC should require such field trials to qualitatively measure the interference experienced by receivers such as the YB-400 operating with its attached whip antenna in such an environment. Just as the Food and Drug Administration requires manufacturers of new drugs to prove they are both effective and safe, the FCC must put the burden of proof on manufacturers of BPL systems to show they will not inhibit access to international radio broadcasts in typical listening environments. Of course one way to eliminate such a strenuous burden of proof would be to confine all such systems to the 30 to 47 MHz part of the spectrum.

FCC Inquiry:

- Are there test results from field trials of Access BPL that may assist in the analysis of harmful interference? Inasmuch as In-House BPL equipment is already on the market, are there any reports that may assist in the further analysis of harmful interference?[1]

NASWA Response:

- Yes, tests have been conducted by the HomePlug® Alliance and the American Radio Relay League to measure the effect of simulated HomePlug® devices on reception in the HF spectrum in real-

world homes with external HF antennas. The bottom line results show that with a 30 dB reduction of radiated components in the amateur radio band frequencies, compared to levels permitted by Part 15 regulations, the effects could be reduced to almost inaudible levels as long as the receive antenna was located 10 meters or more from the house wiring. The report is available on the Internet at:

. <http://www.arrl.org/tis/info/HTML/plc/files/HomePlug_ARRL_Dec_2000.pdf>

Analytically scaling these results to account for the closer spacing to house wiring of shortwave receivers with attached antennas would mean that 70 dB of attenuation below existing Part 15 limits would be required to eliminate interference to shortwave listeners.

- This frequency avoidance approach used in the above tests to protect the amateur radio service does not protect the HF broadcast bands that are the concern of NASWA. A few data points taken in the referenced tests in specific HF broadcast bands showed noise floors were raised as much as 14 dB when the HomePlug® device was turned on. The effect on receivers with built-in antennas in close proximity to house wiring is expected to be much greater. The FCC uses a scaling factor of 40 dB when transferring measurements made at 3 meters distance to the 30 meter distance specified in Part 15 rules. That would imply at least 40 dB of additional protection is necessary in order not to interfere with reception of international HF broadcasts on receivers with attached antennas in the home, and near house wiring.

- If 70 dB (30 dB from the HomePlug®/ARRL tests plus 40 dB of additional protection due to receive antenna proximity to the house wiring) of protection were to be afforded to the HF broadcast bands, there is a serious question whether there would be enough spectrum left for HomePlug® products to achieve commercially competitive data rates. The best solution would be to relocate BPL signals to the 30-47 MHz frequency range which is relatively vacant in residential areas in the USA and are rapidly becoming more vacant as public safety services migrate to 800 MHz digital trunked networks.

- The FCC can benefit from an abundant body of research that has been documented by researchers in other countries. Tests have been in progress for over a year and many organizations have published results. Agencies have investigated the threat to amateur radio, radio astronomy, and international broadcast reception. Summaries of those studies and links to the detailed reports are included below. These reports are unanimous in their conclusions that BPL and HF reception are incompatible. Up to 70 decibels of interference suppression are needed in some cases to eliminate degradation of the noise floor when receive antennas are located inside homes near the wiring in the wall. Some organizations approach the problem of interference by negotiating notches in the spectral mask corresponding to current HF amateur radio service allocations. These notches do nothing for international broadcast listeners or radio astronomers. Worse, this approach forever limits the FCC's future flexibility to reallocate spectrum as future needs evolve. Once installed widely, the BPL technology will be prohibitively expensive to modify to accommodate new frequency usage assignments. The following abstracts were obtained from the ARRL web site and are reproduced here with permission:

- The Japanese Amateur Radio League (JARL) has been deeply concerned about power line communications (PLC), and firmly expressed strong opposition to the Ministry of Public Management, Home Affairs, Posts and Telecommunications (MPHPT.)

  On April 30, 2002, the Ministry's study group on PLC held its first public hearing with JARL, Association of Radio Industries and Business, and others. At the meeting, the results of

collaborated field tests, which were held in January 2002, were reported. The tests included monitoring leakage of electric waves from power lines -- specifically in cases of providing Internet access via power lines to homes.

In this way, JARL actively cooperated with the group. Even more, at the group's request, JARL dispatched one of its directors, Mr. Masao Matsumoto, JA1AYC, to Germany to conduct research on the PLC situation in Europe.

As a result, MPHPT's study group officially announced in its fifth meeting on July 31 that it is too early to allow PLC between 2 MHz and 30 MHz due to hazardous effects on HF users. Major newspapers including Yomiuri, Asahi and Mainichi, as well as the major financial daily, Nihon Keizai Shimbun reported this news.

- Several Japanese tests have been conducted which show that BPL technology and HF broadcast reception are incompatible if the BPL system uses HF frequencies. Here is a link to the report summarizing these tests: http://www.qsl.net/jh5esm/PLC/JARLcampaignPLCe.pdf. These tests formed a basis for the Japanese Government deciding to not approve BPL technology "at this time."

- **The following 2 papers were also presented at the ISPLC2003 Symposium:**
  Internet: http://www.qsl.net/jh5esm/PLC/isplc2003/isplc2003a7-1.pdf
  Summary: Power line communication (PLC) system which extends the available frequency bandwidth up to 30 MHz has been proposed in Japan. The electromagnetic interference problems on PLC had been investigated by the PLC study group organized by the Ministry of Public Management Home Affaires, Post and Telecommunications (MPHPT). The study group held collaborated field experiments of the PLC facility and measured interference caused by the PLC facility in the HF and UHF bands in order to evaluate the influence of the expansion of PLC bandwidth on radio astronomical observations. In the field experiment, two sets of PLC modems (SS and OFDM) were tested as an access system. During the time PLC modems were on, the HF spectra observed showed a strong increase of the noise-floor level, and it was found that the PLC noise exceeded the level of galactic noise by more than 30 dB. In the UHF band, spurious emission around 327 MHz was identified. In both the HF and UHF bands, the interferences exceeded the limit of harmful interference level for radio astronomical observation which is given in Recommendation ITU-R TA769-1. Safety distances where the Recommendation was satisfied are estimated to be 219 km and 12 km at 9.2 MHz and 327 MHz, respectively. PLC seems to be a harmful interference source for the radio astronomical observation in both HF and UHF bands.
  Authors: F.Tsuchiya, H.Misawa, T.Nakajo, I.Tomizawa, J.Nakajima, M.Ohishi, M.Tokumaru, T.Ono and A.Morioka

- M.Tokumaru, T.Ono and A.Morioka **Sharing studies between the radio astronomy telescopes and the power line communication systems in the HF region**
  Internet: http://www.qsl.net/jh5esm/PLC/isplc2003/isplc2003a7-4.pdf
  Summary: Radio Astronomy has frequency allocations in 13.36-13.41 MHz and 25.55-25.67 MHz on a primary basis worldwide. These bands are extensively used by radio astronomers to observe electromagnetic waves emitted by the Sun, Jupiter and other large, gaseous planets in the solar system. The powers from a single PLC system in the above radio astronomy bands are --33 dBW and --29.2 dBW respectively and therefore the PLC systems seem to be a harmful

interference source for the radio astronomical observation in the HF band. It is necessary to keep an adequate separation distance to avoid harmful interference to the radio astronomy telescope, and we calculated the separation distance based on the free-propagation method. We obtained a value of 424 km. If the PLC system is widely deployed, it is sure that the interference level would increase greatly and the separation distance will become much larger. Thus it was recognized that it is quite difficult to share frequencies with the PLC systems and radio astronomy telescopes, at least, in Japan, and that a new technology to dramatically reduce leaked emissions from the power lines are crucial for the PLC systems to coexist with other radio communications services.
Authors: by M.Ohishi, J.Nakajima and M.Tokumaru

- PLC Measurements in the Netherlands (Vereniging voor Experimenteel Radio Onderzoek in Nederland) (VERON)**The Radio Amateur and the Effects of the Use of the 230-Volt Power Line for Broadband Data Communications**
  Internet: http://www.darc.de/referate/emv/plc/VERON_PLC_Report.pdf
  Summary: This 38-page technical paper starts with a PLC tutorial, then outlines the test methods and results of PLC testing by Dutch amateurs. At the turn of the year 2002 a series of measurements was conducted to evaluate the risks of interference by PLC for the amateur station PA0KDF. Both in-house and outside field strength measurements were taken and compared with the CEPT proposed radiation limits (NB 30, Norwegian Limit and BBC limit). In addition the coupling between the mains wiring and the antennas of the amateur station was determined. In an audio test, where use was made of amateur antennas and receiver, the level of interference in the HF amateur bands was evaluated. Only in the case of the strictest limit, the BBC limit, was adequate protection provided against mains injected interference signals. In addition measurements were performed to find the "normal" interference levels on the mains wiring. First, it became apparent that the present interference levels in a quiet rural area are far below the CISPR 22 limits and second, injection of interference signals with a level equal to the CISPR 22 limit level causes harmful interference to the reception of signals in the amateur bands.
  Author: Koos Fockens, PA0KDF

- **NUON discontinues PLC test (Dutch)**
  Internet:
  http://www.webwereld.nl/nieuws/14920.phtmlhttp://www.webwereld.nl/nieuws/14920.phtml
  Summary: NUON in the Netherlands is not going to offer its digital services through the power lines any longer. It will stop its services in the beginning of July. They have determined that the technology is too limited and that it is still not commercially attractive to offer Internet services through the power lines. NUON claims that the test they performed shows that it is possible to offer Internet services on a small scale. However, the technology is not ready yet for large-scale applications. One of the biggest problems is that it is very susceptible to interference. The Telecom Agency of the Dutch Government has determined through measurements that signals are too strong and cause interference to radio communications.
  Author: Webwereld

- **HF radio reception compatibility test of an in-house PLC system using two brands of modems.**
  Internet: http://www.arrl.org/tis/info/HTML/plc/files/ModemRPRTVeron11-04-03.pdf
  Summary: Tests have been performed on the EMC of two types of in-house PLC modems, developed according the HomePlug® standard, that recently appeared on the European market. Some measurements were done in a laboratory set-up (mains disturbance voltage, field strength,

background noise), other were performed in the house of the author (interference on amateur radio receiving antenna, background signals and noise on mains). One type PLC modem seems just to meet the mains disturbance limit in EN55022 for residential environment, the second type showed a level which was approximately 20 dB higher. Under the condition that the in-house PLC modem complies with the current EN55022 B standard, and that the modem additionally uses notches for the bands of the amateur services according to the Homeplug® standard, the general conclusions drawn were: Only when a reasonably well-constructed outdoor antenna is used the interference from the modems is probably not a threat to the radio amateur service; Outside the notches harmful interference may be caused to the broadcasting services; In the laboratory environment with many PCs running, as well as in the author's home environment, the background mains disturbance level was 30 or more dB's below the EN55022 B limit.
Author: VERON EMC Committee, Koos Fockens, PA0KDF

- **Notes on the Final Report of the RA's TWG on the Compatibility of DSL and PLT with Radio Services 1.6 to 30MHz Compiled by the RSGB for the benefit of Radio Amateurs**
  Internet: http://www.qsl.net/rsgb_emc/Notes%20on%20Fin%20Rpt%20Ver%201.pdf
  Summary: This Radio Society of Great Britain summary of the work of the British government's Radio Communications Agency Technical Working Group on DSL and PLC the WG's position on PLC, the extent of the interference problems reported and expected with PLC and lists a number of papers that have been produced by companies and organizations that support this conclusion.
  Author: RSGB

- **The DSLPLC WG Final Report - UK Technical Working Group (TWG) on Compatibility Between Radio Services and VDSL + PLT Systems Operating between 1.6 and 30 MHz**
  Internet: http://www.radio.gov.uk/topics/interference/documents/dslplt.htm
  Summary: This summary report of the British Radio Communications Agency (RA) TWG concludes, "Field tests were undertaken by Agency officials to determine the possible levels of emissions from VDSL and PLT access systems respectively. The scope of this practical work was, by agreement, necessarily limited due to constraints on time and available facilities. It is accepted therefore that the significance of the results is correspondingly limited insofar as neither the VDSL or PLT access test arrangement was truly representative of likely practical commercial deployments. Nevertheless, sufficient data was gathered which enabled TWG to conclude that there is a finite possibility of interference to radio systems when operated within a few metres of cables or wires associated with VDSL or PLT systems. The propagation characteristics of the HF bands are unique in that it is possible, under certain conditions, to provide extended communications over exceptionally long distances, several thousand kilometres being a reasonable expectation under ideal conditions. This means that the bands are particularly valuable for international broadcasting; military applications; long distance maritime and aeronautical communication & navigation, and as a challenging recreational pursuit for amateur radio enthusiasts looking to develop techniques to establish contact over increasingly long distances taking account of prevailing conditions. But such extended propagation is variable, depending very much on seasonal conditions and natural changes in the ionosphere. This means that planning HF systems requires quite different techniques and assumptions to those used in higher order bands, where the limit of expected service area can be predicted with a high level of confidence." This committee report does not represent the official position of the British government.
  Author: UK Technical Working Group

- **RSGB EMC PLT Position Paper**
  Internet: http://www.qsl.net/rsgb_emc/emcplc.pdf
  Summary: The Radio Society of Great Britain raises a very robust objection to the current commercial proposals for PLT in the High Frequency spectrum with the currently suggested radiation levels. The Society will take all measures open to it to oppose the introduction of such mains HF signaling. The Society supports the introduction of broadband technologies provided they do not exceed a level allowing radio and telecommunications apparatus to operate as intended. The Radio Society of Great Britain recommends that all proposals for standards that would allow PLT to operate in the High Frequency spectrum be firmly rejected unless the signal levels are within the existing standards for mains conducted emissions or unless a specific frequency allocation is made for PLT that is compatible with radio services in the HF band.
  Author: RSGB

- **Notes on the RSGB Investigation of PLT Systems in Crieff**
  Internet: http://www.qsl.net/rsgb_emc/CRIEFF%20Notes%20Version_1.html
  Summary: A summary of the RSGB field measurements made of the Crieff field trials. The report noted interference, but felt that more study was needed to quantify it more precisely.
  Author: RSGB**,** Robin Page-Jones (G3JWI)

- **PLC in Finland**
  Internet: http://www.darc.de/referate/emv/plc/plc-oh.pdf
  Summary: PLC for the present rejected by Finnish Telecommunication Minister. In the Finnish Amateur Radio League's monthly magazine "Radioamatööri" 06/2001 on pages 12 to 17, there is an article about a session held on PLC in the Finnish Telecommunication Administration Center (Telehallintokeskus, THK) on May 16 th , 2001. The Finnish Minister of Transport and Telecommunication, Mr. Olli-Pekka Heinonen, had answered to the question of a Member of Parliament regarding the introduction of PLC in Finland: For the present, because of the technical problems encountered, introduction of PLC technology is not possible.
  Author:

- **PLC in Poland**
  Internet: http://www.darc.de/referate/emv/plc/plc-in-poland.html
  Summary: Translation of newspaper article.
  Author: Daily Warsaw Newspaper "SUPER-EXPRESS" - 12.11.2001

- **Status on EMC requirements for PLC equipment and networks** 20-6-02
  Internet: http://www.darc.de/referate/emv/plc/status-plc_iaru-r1.pdf

- **PLT Symposium Friedrichshafen 2002**
  Internet: http://www.darc.de/referate/emv/plc/plt-symposium.pdf
  Summary: MINUTES OF THE PLT SYMPOSIUM. Held on Saturday 29 th June 2002 at the Friedrichshafen, Hamradio 2002.
  Authors: Chairman: Karl Vogel, DK9HU. DARC, Secretary: Peter Kirby, G0TWW. RSGB

FCC Inquiry:

- Are the existing Part 15 rules for low speed carrier current systems adequate to protect authorized users of the spectrum who may be affected by the new high speed BPL technology? What changes to these rules, if any, are necessary to protect authorized radio services?

NASWA Response:

- The standards for interference must be tightened over those that presently apply to Part 15 devices. When Part 15 regulations were established decades ago, people who desired to listen to foreign broadcasts on the HF spectrum typically erected outside wire antennas which could be given sufficient physical spacing from power lines to avoid interference from conductive and radiation fields on both power lines and house wiring. These big antennas were required because the broadcast stations typically ran only 50 kW and the vacuum tube receivers of the day were noisier than today's solid-state designs. Current local government and restrictive deed regulations often do not provide the HF listener any way to use an outside antenna. Outside receiving antennas are prohibited by most modern restrictive covenants and many zoning ordinances for residential communities. (No relief was given to HF radio listeners when the FCC ordered reasonable accommodation for amateur radio service antennas in local zoning processes and the FCC did not pre-empt restrictive covenants that banned outside antennas when the Commission took such action for TV and Direct Broadcast Satellite antennas.)

- A modern Grundig, Sangean, or Sony "shortwave" radio has sufficient sensitivity to hear signals near the atmospheric noise floor using small, attached-whip antennas more often than not located within a few meters of house wiring. Any BPL solution must specify radiated and conducted interference limits that recognize the performance of modern receivers and the way they are used by most listeners. Receivers with noise floors in the neighborhood of 1 microvolt across 50 ohms in a 5 kHz bandwidth are typical for the better portable radios with "shortwave" capability. Moving the BPL frequencies to the band between 30 and 47 MHz will greatly reduce the interference mitigation techniques that would otherwise be required to protect HF broadcast reception.

- The following report demonstrates the inadequacy of current part 15 limits with today's sensitive receivers: **Interference Case History from Wireless Modem Jacks**
  Internet: http://www.arrl.org/tis/info/rfiteljx.html
  Summary: This is a case history of severe interference to Amateur Radio from a device that had been Verified under FCC Part 15 to be in compliance with the rules. The manufacturer was very responsive and corrected the interference by redesigning the product not to use Amateur frequencies. The devices were deployed widely and the end user ultimately had to do a system-wide recall in the field. ARRL appreciates that those involved acted appropriately, but this serves as a good case history about the level and degree of interference that can come from devices that are at the current FCC limits, and of the costs to industry that can result if interference is not mitigated at a product's initial design. The model under discussion has not been in production for several years and the company's present products are not known to present any significant interference potential.
  Author: ARRL, Ed Hare, W1RFI@arrl.org

FCC Inquiry:

- How should the Part 15 rules be tailored both to ensure protection against harmful interference to radio services and to avoid adversely impacting the development and deployment of this nascent technology?

NASWA Response:

- As noted above, it will be extremely difficult to deploy systems using frequencies identical to

those used by international broadcast listeners, radio astronomers, and operators in the amateur radio service. The only way NASWA sees to facilitate both economical and effective deployment of this technology while protecting the ability of existing spectrum users to continue using their allocations is to use the spectrum between 30 and 47 MHz for BPL applications. Part 15 rules can be tightened as necessary to avoid interference to and from the few remaining public safety and military mobile users of this frequency range. Failure to adopt this recommendation will result in interference to shortwave broadcast reception unless radiated levels are limited to 70 dB below present FCC Part 15 permissible levels as previously noted.

FCC Inquiry:

- Given their different operating environment, is it necessary to tailor the rules to differentiate equipment used specifically in Access BPL and In-House BPL applications, or should one set of general limits be applied to both? What should such limits be and what is the technical basis for them?

NASWA Response:

- Rules should be results driven. Limit the field strength to that which modern shortwave radios, operating on attached whip antennas, experience an interference level that raises the noise floor to no more than 1 dB above the atmospheric noise level in the range of 2.0 to 26 MHz at a distance of 1 meter or less from normal Romex type house wiring (no BX cable sheath allowed). Because the limits are constrained by the sensitivity of modern receivers, there is no need to set different Part 15 limits between Access BPL and In-House BPL devices.

FCC Inquiry:

- Is there need to specify different limits for Access and In-House systems? For example, would it be appropriate to allow higher emissions for In-House systems where the user would be the principal party affected by interference, and could take steps to mitigate the interference, than for Access systems where the interference would affect a wider area and therefore be more problematic to mitigate? Would higher emissions for In-House systems result in any interference effects in other houses or apartments sharing the same local low voltage distribution by the RF signal being distributed on the low voltage side of the transformer? What limits should be specified, given the above considerations?

NASWA response:

- It would not be appropriate to have less stringent limits on In-House devices. As noted by the FCC in the NOI, several homes are normally connected in parallel at the secondary of the low voltage distribution transformer. A neighbor's In-House devices will strongly couple into the wiring of all homes connected to the same secondary. If high-pass devices are installed around the distribution transformers in a neighborhood, the In-House signals will propagate even further via the medium voltage distribution wires. The affected HF broadcast listener would have no control over the interference caused by a neighbor's device. Consider too that BPL systems must always be "on" if they are going to compete economically with DSL and cable modems. Even if the user elected to shut off his own BPL device so he could listen to foreign broadcasts, he would likely be bouncing e-mail traffic during the time his BPL device was down. Shutting off the BPL devices is not the answer. Moving these signals to the 30 to 47 MHz frequency range is a better solution.

- The allowable limits should be determined empirically via a series of real-world tests. The standard

should be that a modern portable shortwave radio, similar to the Grundig YB-400, operating on its attached whip, at 1 meter from the house wiring should experience no more than a 1 dB rise in noise level above atmospheric noise at any frequency between 2 and 26 MHz.

FCC Inquiry:

- Should the Part 15 rules specify both radiated emission limits and conducted emission limits for BPL systems, or would one type of limits be sufficient to control interference from both low speed and high speed BPL? Since all carrier current systems inject RF signals into the power line for communication purposes, would conducted emission limits be more appropriate to protect authorized radio services?

NASWA Response:

- Both radiated emission limits and conducted emission limits should be controlled by FCC regulation. Because the wires are unshielded, currents conducted in the wires will radiate. How much they radiate is not under the control of the BPL device manufacturer nor the BPL service provider. The wires are already in the wall or on top of the ceiling. What is there is there and only the building owner can legally change that. Houses built in the last few decades universally use unshielded Romex type wiring in place of the older BX type metal sheathed cables which were common in the 1950's and earlier. The Romex style cable being unshielded will radiate and there is nothing the homeowner can do short of ripping out the house wiring and replacing it with grounded, shielded cable. Such an alternative will logically cause the homeowner to opt for the more economically attractive cable modem or DSL approaches for broadband access. BPL could die before it ever gets off the ground unless the FCC limits conducted and radiated emission levels. Moving the BPL spectrum to 30 to 47 MHz will help the FCC to specify less stringent limits.

FCC Inquiry:

Radiated emission measurements of carrier current equipment at frequencies below 30 MHz can be time consuming and difficult to make because each installation's wiring is unique. The variations in wiring across different installations pose problems for achieving repeatability of results and for finding installations that can be considered representative. Currently, there are no specific test methods in our rules for carrier current systems, rather, measurement procedures have been left to the discretion of the party performing the tests, and thus measurements can be subjective and inconsistent. Furthermore, Access BPL equipment presents unique measurement challenges because it is typically installed on utility poles and operated over medium voltage lines. We therefore request comment and input on the following questions:

- How should the measurement procedures for testing existing low-speed carrier current systems be developed in order to avoid the burden of selecting representative installations and to promote consistency and repeatability of test results? Is it possible to develop a standardized measurement method for testing in a laboratory or at an open area test site using some characterized wiring assembly or artificial impedance network? If so, how?

NASWA Response:

- NASWA agrees that the widely varying conditions between installations make meaningful

measurements very difficult. In view of the complexity of this issue and the uncertainty in any test results, NASWA recommends that the issue should be avoided all together. Only allow In-House and Access BPL devices to use frequencies between 30 and 47 MHz. Here radiated limits can be much higher and test uncertainties become less consequential.

FCC Inquiry:

- How should In-House BPL systems be tested for compliance, given that they use the building's wiring as an antenna? The impedance characteristics of in-house wiring changes each time an appliance is turned on or off, which makes modeling this varying impedance a challenging task. Is it possible to develop a standardized measurement method for testing In-House BPL in a laboratory or at an open area test site using a specialized LISN or some characterized wiring assembly? If so, how? Would the same method of measurement be sufficient to test both traditional carrier current system and new high speed In-House BPL?

NASWA Response:

- NASWA agrees that because the wiring of a house is such a big and uncontrollable component of the radiated signal environment that setting of limits and measurement of compliance is an almost impossible task. That is why NASWA recommends that BPL devices should not attempt to frequency share portions of the spectrum that are used in homes to receive international radio broadcasts. Moving the BPL spectrum to the 30 to 47 MHz range would relax the need for strict emission standards and test measurements

FCC inquiry:

- Are there any international standards that should be investigated for possible adoption in order to facilitate the development of BPL products for a global marketplace?

NASWA Response:

- Each country seems to be developing its own BPL standards. There is little international coordination. Even the acronyms used to describe this new technology have not been standardized. Broadband Power Line (BPL) in the USA is Power Line Communications (PLC) in Japan, The Netherlands, Poland and Finland; Power Line Transmission (PLT) and Power Line Communications (PLC) are both used in the United Kingdom and Germany depending on which paper you are reading.

- Any system that is marketed on a worldwide basis must protect the rights of billions of people who only have shortwave radio to bring them the truth. The FCC must understand that in many parts of the world, where local despotic governments control the only local radio stations, listeners use shortwave radios to hear the truth from international sources. Today some people risk their lives to hear international broadcasters delivering the real news of the world and home country events. The United States Government devotes hundreds of millions of dollars each year to such broadcasting. Wouldn't it be ironic if "Made In The USA" BPL devices, allowing access only to internet sites that the local dictator approved of, were the very cause of interference that prohibited oppressed peoples from hearing these shortwave transmissions? Any system deployed in the USA will likely be aggressively marketed overseas. Our system must, therefore, also protect foreign shortwave listeners' rights to hear the truth unencumbered by local government restrictions. That will not only be in the interest of the US Government but also in the interest of all the world's citizens who value freedom and aspire to more democratic societies.

FCC Inquiry:

However, the multiple-carrier transmission nature of the new high speed BPL technology could pose increased risk of harmful interference, and thus new BPL devices may need a higher degree of oversight to ensure that authorized users are not subject to interference. Accordingly, we seek comment on the following questions:

- Would the new high speed Access and In-House BPL equipment pose a higher risk of interference to licensed radio services than the traditional carrier current systems?

NASWA Response:

- Yes, the new equipment currently undergoing field trials shares spectrum with international broadcast frequencies. Broadband signals are necessary due to the high data rates that must be used to be economically competitive with DSL and cable modems. Existing carrier current systems are relatively low data rate signals with narrow bandwidths and do not generally use HF spectrum that is used by international broadcasters. The inherent risk of interference is greatly increased because of the lack of a defined environment for the wiring and receiver antenna coupling to the house wiring. NASWA recommends redesigning the BPL standards to use frequencies in the 30 to 47 MHz spectrum range.

FCC Inquiry:

- We seek information on the subject of communications over electric power lines from all interested parties to obtain a wide representation of viewpoints. Accordingly, we request comments on any other matters or issues, in addition to those discussed above, that may be pertinent to BPL technology.

NASWA Response:

- Power utilities will be responsible for the safety of devices they install to enable Access BPL technology. The Commission must ensure that transformer by-pass devices, used for Access BPL applications, cannot fail in a way that might place thousands of volts (from the medium voltage distribution network) on home wiring and devices. Consumers must be assured that this technology is safe if Access BPL is to find wide acceptance. Protective schemes, such as fuses, must be proven to act fast enough to prevent electrocution or equipment damage for all possible failure modes.

Respectfully submitted,

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